# Exo Skeleton Arm: Load Bearing Application

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**Abstract**: Lately delicate wearable exoskeletons, usually alluded to as exo-suits, have been broadly utilized in human help. Consequently, a mutual approach for a methodical and comprehensive control design is critical. The majority of the exo-suits grew so far utilize a link transmission to advantageously put the actuator far from the end-effector. While having numerous focal points this activation technique shows some characteristic impediments caused by non linearities, for example, rubbing and friction of the links, which make it hard to anticipate and control the elements between the arm and the client. The report exhibits a novel technique for the arm exoskeletons that considers the solid power manipulability of the human arm. We propose a model that gives help without considering the biomechanical properties of the human arm.

**Keywords:** Exo suits, manipulability, biomechanical properties.

## INTRODUCTION

With the consistently developing industry, the productivity is additionally anticipated that would increment. The nations where the business sectors have moved onto robotization in their enterprises, the effectiveness had expanded amazingly. In any case, in India, computerization is yet to help. We still vigorously depend on human work; along these lines, the work should be more proficient. This exo arm would enable workers to do their weight lifting errands at double the speed and minimum sweat. The arm would enable the work to spend less vitality and endeavors, with the goal that the workers can give extreme and there would be an unequivocal increment in the proficiency. The Exoskeleton is a mechanical arm that helps muscle development. This arm resembles a helping gadget which enables the human arm to lift more weights with less limitation. This review is a Mechatronics venture where in the microcontroller hardware will control the engine activity (electrical) and the engine activity will move the arm outline (mechanical). This casing will be connected to a wearer's arm with Velcro straps. The arm is designed to the point that it helps the common movement of lifting a protest. Consequently, the arm diminishes the strain on the hand by producing mechanical work.

## LITERATURE SURVEY

Guangye Liang, Wenjun Ye, Qing Xie [1] They developed a robotic exoskeleton used for rehabilitation of upper extremity. They designed a cascadedcontroller for each joint, which consists of speed loop and a position loop, based on the PID control method. Mohammad H. Rahman, Maarouf Saad, Jean P. Kenné[2] They developed an exoskeleton robot(ExoRob) to rehabilitate upper limb motion. It comprised of seven degrees of freedom to enable naturalistic movements of the human upper-limb. A kinematical model of ExoRobis developed here based on Denavit- Hartenberg notations. Binh KhanhDinh, Michele Xiloyannis, Chris Wilson Antuvan, Leonardo Cappello, Lorenzo Masia[3] The proposed control method comprises of three main layers: An active impedance control which estimates the users arm motion intention and guarantees a response of the suit to the wearers motion. A mid-level controller which compensates for the backlash in the transmission and converts the reference arm motion to the desired position of the actuator. A low-level controller which is responsible for driving the actuation stage by compensating for the nonlinear dynamics. Thunyanoot Prasertsakul, Teerapong Sookjit, Warakorn Charoensuk [4] The proposed exoskeleton arm has five degrees-of-freedom. Three degrees-of-freedom are at theshoulder joint, i. e. flexion/extension, abduction/adduction and internal/external rotation. The elbow joint has two degrees of freedom that are flexion/extension and supination/pronation. The exoskeleton arm can be controlled by the electromyography signals and a set of controllers whichcomposes of the electromyography amplifier, analog to digitalconvertor, motor control and motor driver. Computer interface was utilized for design and development of the exoskeleton arm through simulation. Crocher et al. [9] explored the programmable of upper extremity exoskeleton in impose certain joint coordination patterns during rehabilitation. Due to the conventional rehabilitation for upper limb involves the interaction with both upper arm and lower arm, it is expected that the robotic rehabilitation exoskeleton can cover both the end-point control and inter-joint synchronization. An ABLE exoskeleton has been employed in their study.

## OVERALL SCHEMATIC

The arm is made with 0. 6 cm thick and 6 cm wide aluminium strips. The aluminium will have two parts: the upper arm piece and the forearm piece. Also, wooden strips will be attached to these pieces using spacers. The wooden piece will have foam on it so that it doesn’t hurt the human arm. Then velco straps will be added which help to strap the arm to the human hand. The 2 frame pieces are then coupled using a high torque dc motor(40 Kg-cm). The motor will be attached to the upper arm and the shaft will be coupled to the forearm piece using a shaft coupling flange. The microcontroller will be fed with either of the 2 signals by the DPDT switch i. e UP or DOWN. Then the Arduino will send the signal to the L293D motor driver which will drive the motor accordingly. There will be a manual mechanical lever which will help to hold the arm in the UP configuration manually without much stress on the motor configuration. The wearer of the arm will have a wrist lock glove in his hand to further protect the arm from any kind of strain. The frame will be fixed to the human arm using bag straps. The acuation in the arm frame will be done using 40 kg cm 20-30 rpm 12v dc motor. The motor will be supplied by logic input through the l298n motor controller. Depending on the dpdt switch input on the controller either clockwise or anticlockwise rotation will be made by the motor shaft for a picking or a dropping motion respectively. The controller circuit will be strapped on the bagpack along with the motor and battery. The arm will be attached to the bag with straps. The wearer of the bag will fit the arm in left hand and will have a dual switch in the right hand to control the arms direction.

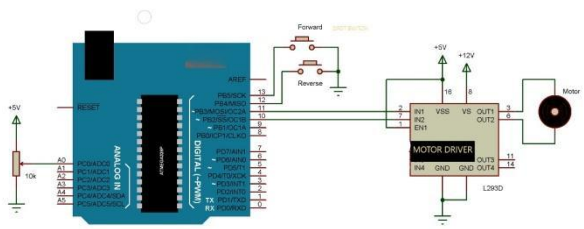


***Figure 1:*** *Circuit Diagram*

## METHODOLOGY

The circuit provides input logic to the motor for its bi-directional motion. This motor is fit on the upper arm piece. Then the 2 arm pieces are coupled through the motor shaft with the help of a shaft coupling flange. This flange is attached to the forearm piece. The wires are carefully guided from the motor to the bagpack holding the circuit and battery. The arm frame is a left-handed frame since the left hand is weaker than right hand. The switch will be placed in the wearers right hand. Then depending upon the required action, corresponding switch is pressed. This signal is fed to the micro controller and the motor shaft rotates clockwise or anticlockwise. This shaft thus actuates the forearm to move up or down, replicating the motion of a human elbow joint. This arm is designed by considering only 1 degree of motion at the elbow. Then a mechanical lever is used to manually lock the arm position in order to hold the respective load. Also, a wrist locking glove is provided to the wearer to prevent injuries to the wrist and provide added assistance.

## SYSTEM AND HARDWARE DESCRIPTION

Our system is an Arduino based exoskeleton arm which uses a switch as a method for the proper lifting up and down of the arm. The user can pick up objects which are beyond his capability. The user can lift and put an object down very easily using switch. The entire system is very easy to use. This exoskeleton arm is so user friendly that the user can easily operate it. By using only a switch the user can pick up and put things down. This exoskeleton arm will provide extra-strength on user's arm which will allow the user to easily pick and put down objects without any hassle. The exoskeleton arm controlling motor and circuit is setup on backpack which allows the user to carry this entire system with him or her anywhere he/she wants. The hardware required is as follows:

- Aluminium frame
- Shaft coupling flange (8mm)
- 12V li-ion Battery
- Arduino Uno Microcontroller
- DPDT centre-off rocker switch (spring action)
- 40 kg cm torque motor
- L298NMotor driver
- Bagpack
- Wood and foam
- 6mm and 4mm nuts and bolts
- Velcro Straps
- Drill machine with 4mm 6mm and 8mm drill bits

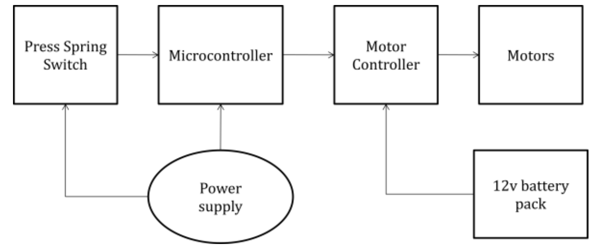


***Figure 2:*** *Block Diagram*

**Arduino Uno**

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller, simplyconnect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

**LN298N Motor Driver**

The LN298N is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals.

**45 Kg-Cm TORQUE MOTOR**

Squared geared DC motor is a very high torque motor which should be used to make big robots or robotized platform. Gear box is built to handle the stall torque produced by the motor. Drive shaft is supported from with metal bushes.

## SYSTEM WORKING

The aim of this project is to design an Arduino based system for controlling a DC Motor. All the connections are made as per the circuit diagram mentioned above. The working of the project is very simple and is explained here. Dpdt switch used in this project, for forward and reverse direction of the motor. The pins of switch are connected to Pins 13 and 12 of Arduino which are internally pulled-up (using code). The other terminals of theArduino are connected to ground and hence when the switch is pressed, the microcontroller detects LOW (logic 0). The output of the POT is an analog signal and hence it is connected to analog pin of the Arduino. Based on the analog voltage value from the POT, the speed of the motor is varied. For this to happen, we need to use the concept of PWM in the circuit. The inputs to the motor driver IC must be in the form of a PWM signal and hence are connected to Pins 11 and 10 of Arduino respectively, which are capable of generating PWM signals. When the system is powered ON, Arduino waits for the switch to be pressed. If the forward direction is pressed, the Arduino drives input 1 of motor driver IC (Pin 2) with PWM signal and a logic low to input 2 (Pin-3). Hence, the motor starts rotating in forward direction. Similarly, if the reverse direction switch is pressed, Arduino drives input 2 (Pin 3) of L298N Motor Driver IC with the PWM signal and input 1 (pin 2) of L298n is given a logic low. Hence, the motor starts rotating in reverse directions. The speed of the motor in either direction can be controlled using the POT as it controls the duty cycle of the output PWM signal.

## SOFTWARE DESCRIPTION

### Arduino IDE

The Arduino integrated development environment (IDE) is crossplatform application that is written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

## CONCLUSION AND FUTURE SCOPE

Rehabilitation robots have become important tools in stroke rehabilitation. Compared to manual arm training, robot-supported training can be more intensive, of longer duration and more repetitive. Therefore, robots have the potential to improve the rehabilitation process in stroke patients. Whereas a majority of previous work in upper limb rehabilitation robotics has focused on end-effectors-based robots, a shift towards exoskeleton robots is taking place because they offer a better guidance of the human arm, especially for movements with a large range of motion. However, the implementation of an exoskeleton device introduces the challenge of reproducing the motion of the human shoulder, which is one of the most complex joints of the body. Thus, this paper starts with describing a simplified model of the human shoulder. On the basis of that model, a new ergonomic shoulder actuation principle that provides motion of the humorous head is proposed, and its implementation in the exoskeleton arm therapy. In future we are going to try to change the control panel switch easier and we will replace it with pressure sensor. Furthermore, we will try our best to make it work with brain waves.

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